

NEW CLIMATE SCIENCE FINDINGS

Since the Second IPCC Assessment in 1995, the scientific evidence concerning human influences on the global climate system has continued to accumulate. In particular, recent data and analyses strengthen earlier findings that the surface temperature of the Earth is increasing and that this increase can be attributed, in large part, to human-caused increases of greenhouse gases in the atmosphere. The continuation of these trends is likely to be associated with climatic changes capable of adversely affecting ecosystems, wildlife, and large numbers of people.

Northern Hemisphere Temperatures Warmest in 1,000 years

Recent studies published in *Nature*, *Science*, and *Geophysical Research Letters* have provided additional evidence of 20th century warming. Analysis of tree rings, corals, ice cores, and lake sediments showed this century's surface temperatures for the Northern Hemisphere to be the warmest since at least 1400 A.D. A newer study of Northern Hemisphere temperatures found it highly likely that the 20th century has been the warmest century of the millennium; the 1990s have been the warmest decade; and 1998 has been the warmest year. A study of temperature data from 600–1,800-foot deep boreholes in North America, Europe, Africa, and Australia found that the Earth's average surface temperature has increased by about 1.8° Fahrenheit (F) over the last five centuries, and that half of this total warming occurred in this century.

(Mann *et al.*, *Nature*, Vol. 392 (1998), p. 779; Mann *et al.*, *Geophysical Research Letters*, Vol. 26, No. 3 (1999), p. 759; Pollack *et al.*, *Science*, Vol. 282 (1998), p. 279.)

The 11 Warmest Years Have All Occurred Since 1983

Of the 120 to 140 years for which thermometer records are sufficiently complete to define a global average temperature, the 11 warmest years have all occurred since 1983. The three warmest years on record were 1998, 1997, and 1995, in that order. In addition, 1998 was also 1.2° F above the long-term average temperature—the 20th consecutive year in which this benchmark has been exceeded.

(NOAA National Climatic Data Center, UK Meteorological Office.)

Greenhouse Gases from Human Activities Dominant Driver of 20th Century Warming

The 20th century temperature records are consistent with what is expected under human-induced climate change scenarios and cannot be explained solely by other hypothesis, such as solar variability, volcanic eruptions, and El Niño cycles. The case for anthropogenic climate change is further strengthened by the record of regional patterns of temperature changes across the surface of the Earth and the

vertical patterns of temperature changes as one ascends through the atmosphere.

(Mann *op cit.*; Wigley *et al.*, *Science*, Vol. 282 (1998), p. 1676; Peterson *et al.*, *Geophysical Research Letters*, Vol. 26 (1999), p. 329; Wentz and Schabel, *Nature*, Vol. 394 (1998), p. 661.)

Emerging Scientific Evidence Suggests We May Already Be Seeing Impacts of Climate Change

Changes in species distributions and ecosystem dynamics are likely attributable to multiple causes and stresses, but scientists have deduced that climate change is playing a role in the demise of several frog and toad species in Monteverde, shifts in the growing season in Europe, shifts in growth of grass and forb species in Colorado, changes in bird ranges in western Europe, and alterations in patterns of ocean biodiversity.

(Menzel and Fabian, *Nature*, Vol. 397 (1999), p. 659; Pounds *et al.*, *Nature*, Vol. 398 (1999), p. 611; Parmesan *et al.*, *Nature*, Vol. 399 (1999), p. 579; Alward *et al.*, *Science*, Vol. 283 (1999), p. 229.)

New Study Shows Role of CO₂ in Ice Age Warming

A study of Antarctic ice cores published in the March 12, 1999, issue of *Science* compared changes in temperature and levels of atmospheric carbon dioxide during several ice ages. The study showed that as the Earth began to warm due to minor changes in its orbit, carbon was released from the ocean into the air, raising atmospheric CO₂ levels that then greatly magnified and accelerated the warming process. The study confirms that small changes in the factors that affect climate can have large effects on global temperatures.

(Fisher *et al.*, *Science*, Vol. 283, p. 1712.)